Birds as Indicators of Environmental Contamination in Lake Michigan: GLRI Project 80

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Scope of Work for GLRI Project 80

- Use tree swallows and colonial waterbirds in the Great Lakes to evaluate contaminant -

1) Exposure (spatial)
2) Trends through time (temporal)
3) Effects (reproductive, physiological, genetic)
4) Monitor cleanup actions

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Project 80 is directly relevant to several goals and objectives identified in the GLRI Action Plan in the 'Toxic Substances and Areas of Concern' focus area including:

- Removal of BUIs (and delisting of AOCs)
- Protecting health and integrity of wildlife populations
- Measuring progress in clean-up of AOCs
- Identifying impacts of new toxicants

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Outline

Overview of study – 2010 & 2011

Preliminary Results - 2010

- **Exposure patterns across the Great Lakes**
  Objective 1

- **Temporal assessments**
  Objective 2

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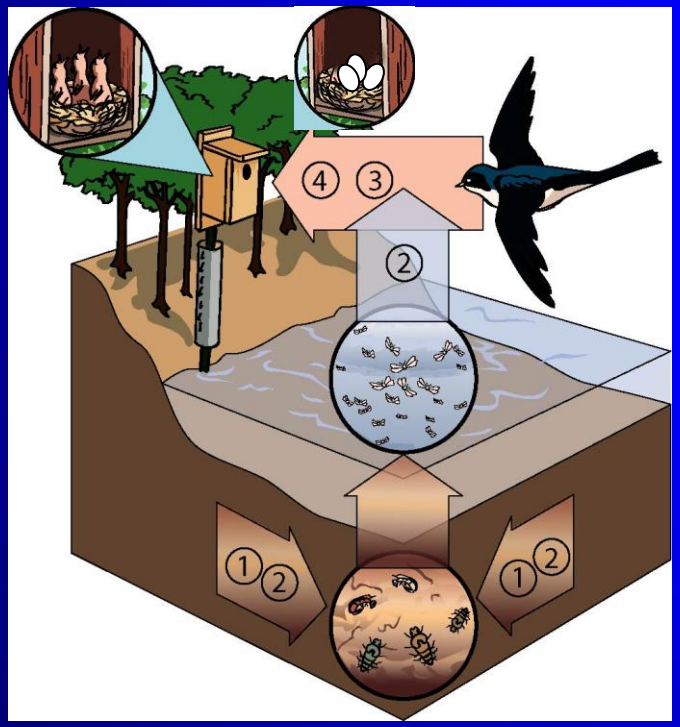

- Close ties to sediment contamination
- Nest boxes at areas of interest
- Adequate sample size
- Localized feeding

- Collecting water bird data as well at selected locations

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Sampling matrices

Organics (e.g. PCBs, PBDE, dioxins & furans, pesticides, and some trace elements [Hg, Se, Cd, etc.])
- Also congeners

Trace elements (liver), PFCs (blood) + organics (carcass for accumulation rate)

Biomarker analyses (EROD, -omics, genetic damage, oxidative stress etc.)

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Progress -

- 32 sites (22 in 2010 ▲ + 10 new ▲ in 2011) have been sampled and contaminant exposure data collected, including data for both legacy and emerging contaminants

- Effects data at many levels of biological organization are also being collected

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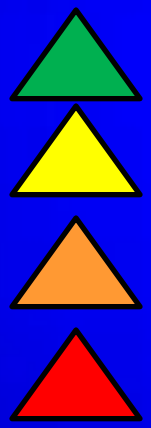
- **Geographic presentation - Consistent matrix across all sites allows direct comparisons among sites**

- **Data are presented in categories for easier comparison across sites**



Lowest concentrations

Highest concentrations

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Organic results

- PCBs
- DDE
- PBDEs
- PFCs

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PCBs

Tree swallows

Wild Rice Lake

St. Louis River

Lake Superior

Green Bay

Sheboygan River

Lake Michigan

Ryerson

Hartshorn

Lincoln Park

Lakeshore Park

Lake Calumet area

Portage, IN

Lake Erie

Lake Ontario

Conners Creek

River Rouge

Wyandotte

Lake Erie MetroPark

River Raisin

Ottawa River

Ottawa Nat'l Wildlife Refuge

Geo. mean (eggs)

- <1 ug/g wet wt.
- 1.0 – 1.9
- 2.0 – 2.9
- ≥3.0

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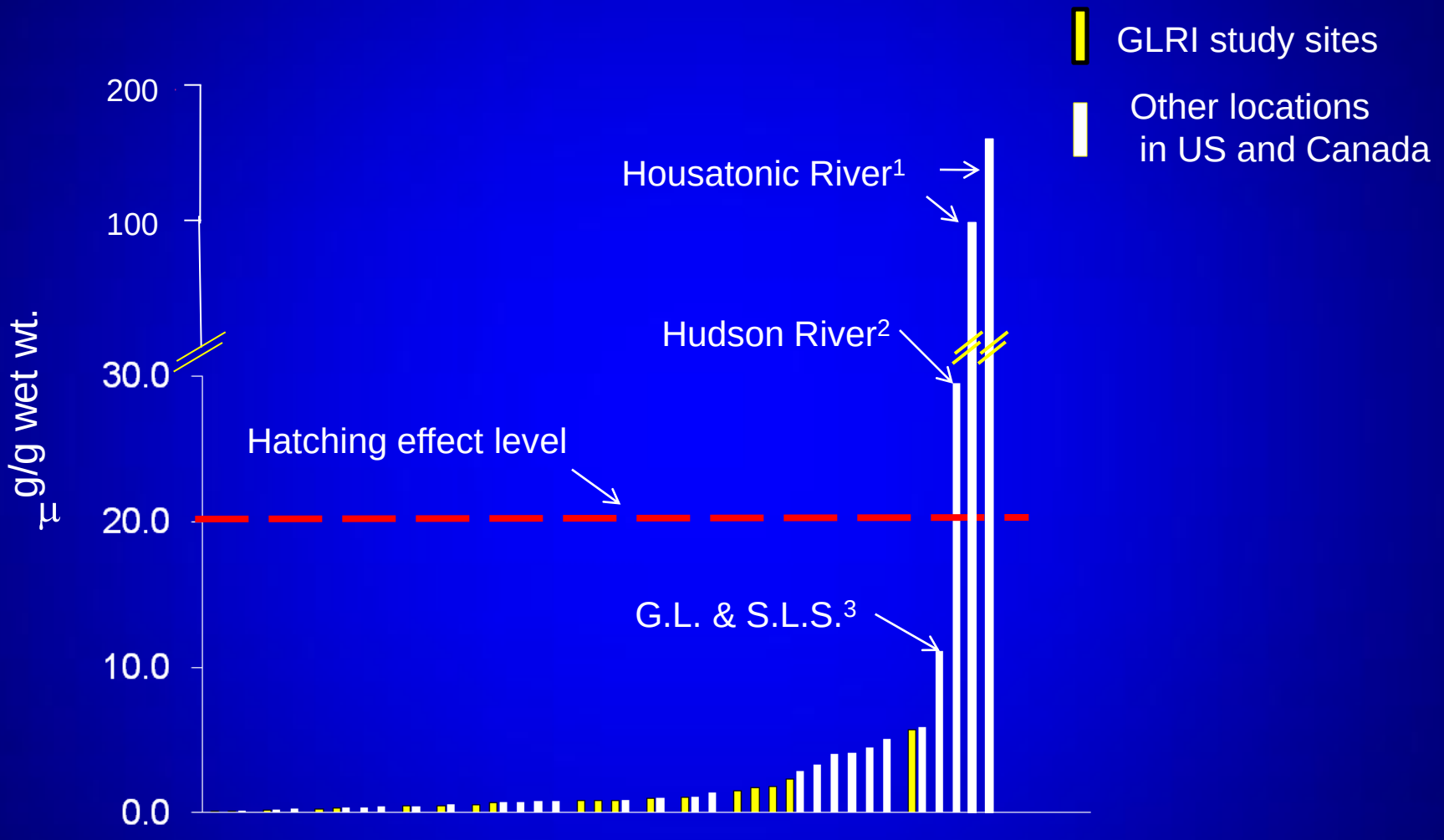
PCB concentrations in tree swallow eggs



[1] Custer et al. 2003, 2007
[2] Secord et al. 1999
[3] Bishop et al. 1999

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Total PBDEs

Lake Superior

Wild Rice Lake

St. Louis River

Green Bay

Sheboygan River

Lake Michigan

Ryerson

Hartshorn

Lincoln Park

Lakeshore Park

Lake Calumet area

Portage, IN

Lake Ontario

Lake Erie

Conners Creek

River Rouge

Wyandotte

Lake Erie MetroPark

River Raisin

Lake Erie

Ottawa River

Ottawa Nat'l Wildlife Refuge

Geo. mean (eggs)

<30 ng/g wet wt.

30 - 59

60 - 89

≥90

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Total PFCs

Wild Rice Lake

St. Louis River

Lake Superior

Green Bay

Sheboygan River

Lake Michigan

Ryerson

Hartshorn

Lincoln Park

Lakeshore Park

Lake Calumet area

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Ottawa River

Ottawa Nat'l Wildlife Refuge

Lake Erie

Lake Ontario

Lake Erie

Geo. mean (blood)

<100 ng/g ml

100 – 199

200 - 299

> 300

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Inorganic results

- Mercury
- Lead
- Selenium
- Chromium

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Mercury

Tree swallows

Wild Rice Lake

St. Louis River

Green Bay

Sheboygan River

Lincoln Park

Lakeshore Park

Lake Calumet area

Portage, IN

Ryerson

Hartshorn

Lake Superior

Lake Michigan

Lake Ontario

Lake Erie

Conners Creek

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Lake Erie MetroPark

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Ottawa River

Ottawa Nat'l Wildlife Refuge

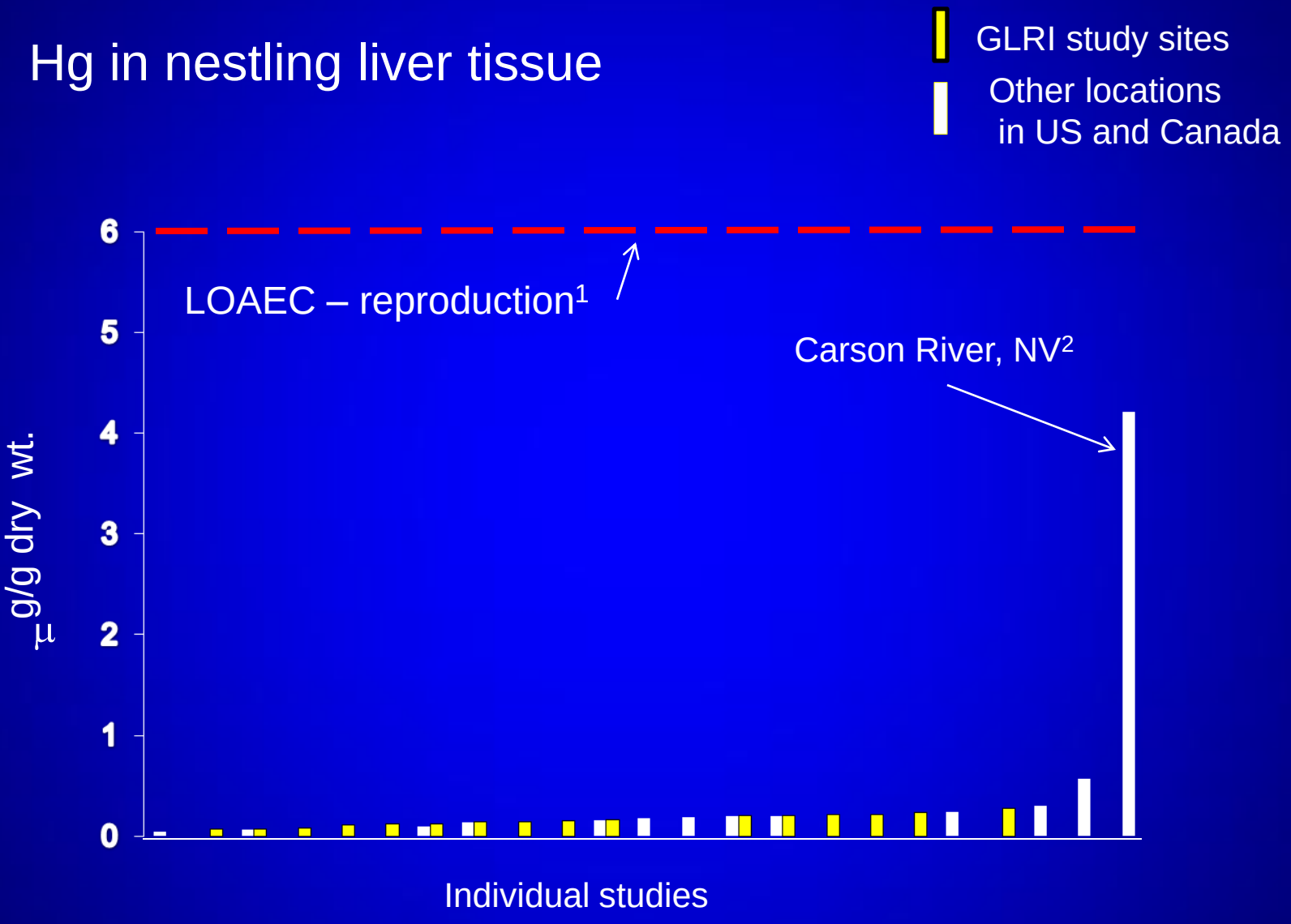
Geo. mean (liver)

- <0.10 μg/g dw
- 0.10 – 0.14
- 0.15 – 0.24
- >0.25

USGS science for a changing world

Custer & Custer, March 2011

Hg in nestling liver tissue



[1] Shore et al. 2011
[2] Custer et al. 2007

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Bioindicators

- EROD activity
- Oxidative stress
- Flow cytometry
- Hormone analysis
- red/white blood cell ratio

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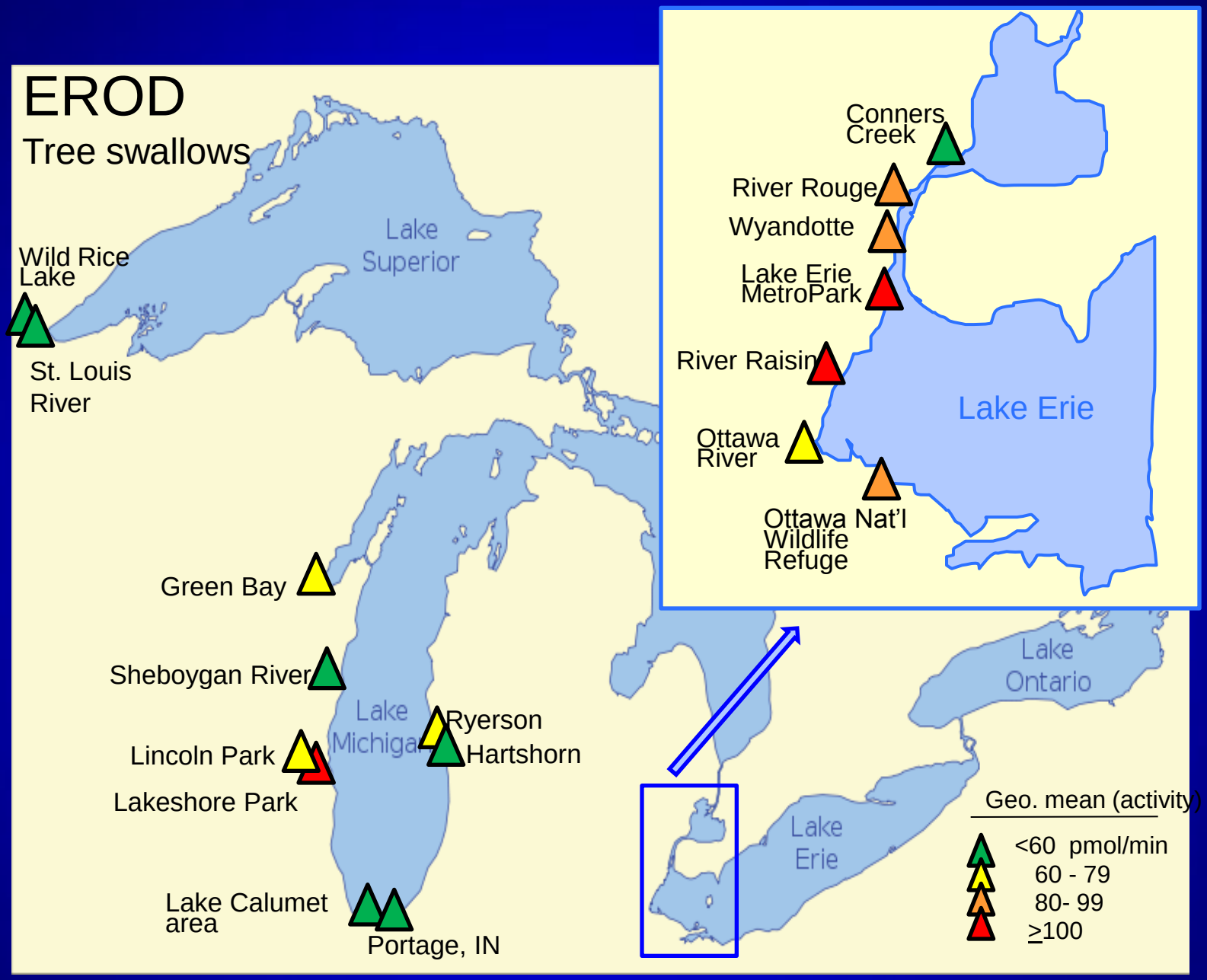
EROD
Tree swallows
Wild Rice Lake
St. Louis River
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River Raisin
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Ottawa River
Ottawa Nat'l Wildlife Refuge
Lake Ontario
Lake Erie
Geo. mean (activity)
<60 pmol/min
60 - 79
80- 99
≥100

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Objective 2
Temporal Trends

Green Bay, WI
Total PCBs (μg/g wet wt.)

Year	geometric mean (eggs)	
	Cormorant	Swallow
1994/1995	13.6	3.3
2010	3.5	1.7

Result of remediation + time?

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Products

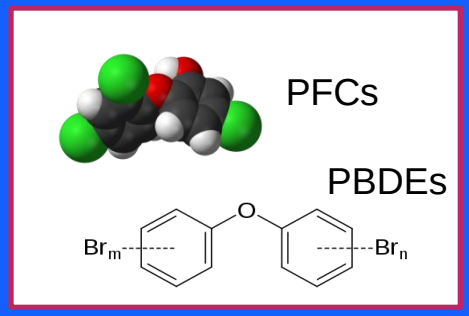
- http://www.umesc.usgs.gov/wildlife_toxicology/glri_project80.html.

Goals and objectives

Maps and habitats at current study sites

Why use swallows?

Preliminary results



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